

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (currently amended) A gas concentration measuring apparatus comprising:

a gas sensor configured to measure a concentration of a specified gas component contained in a gas and to output a sensor current corresponding to the measured concentration of the specified gas component; and

a measurement substrate where an electric circuit is formed, said electric circuit being electrically connected to the gas sensor and including a signal processing circuit configured to measure the sensor current outputted from the gas sensor,

wherein said electric circuit comprises:

a connection terminal electrically connected to the gas sensor and configured to ~~input~~receive the sensor current from the gas sensor, said connection terminal having input impedance of 500 k Ω or over;

a conductive pattern portion having conductivity and formed in the measurement substrate; and

an electric component mounted on the conductive pattern portion,

said conductive pattern portion including:

a signal input pattern ~~constituting the signal processing circuit and~~ electrically connected to the connection terminal, said signal input pattern having direct current impedance with respect to the connection terminal, said direct current impedance being 10 percent or less of the input impedance of the connection terminal;

a different potential pattern having a potential difference of 2 V or over from a potential of the signal input pattern; and

a guard pattern having a substantially constant potential and a potential difference of less than 0.5 V from the potential of the signal input pattern, said guard pattern being arranged on at least a portion of the measurement substrate, said at least portion of the measurement substrate being located between the signal input pattern and the different potential pattern,

wherein the guard pattern is arranged on at least a portion of the measurement substrate, the at least portion of the measurement substrate is located between the signal input pattern and the different potential pattern, the conductive pattern portion includes a signal measurement pattern constituting the signal processing circuit, a potential of the signal measurement pattern depends on that of the signal input pattern, the signal processing circuit comprises an operational amplifier, the signal input pattern is connected to a non-reverse input terminal of the operational amplifier so that the potential of the signal input pattern is input to the operational amplifier via the non-reverse input terminal thereof, an output terminal of the operational amplifier is connected to a reverse input terminal thereof so that the operational amplifier is configured to output, via the output terminal, a voltage that substantially equals to the potential of the signal input pattern, and the guard pattern is electrically connected to the signal measurement pattern.

2. (original) The gas concentration measuring apparatus according to claim 1, wherein said guard pattern has a potential difference of less than 0.2 V from the potential of the signal input pattern.

3. (original) The gas concentration measuring apparatus according to claim 1, wherein said input impedance of the connection terminal has 1 M Ω or more.

4. (original) The gas concentration measurement apparatus according to claim 1, wherein said signal input pattern has direct current impedance of 2 k Ω or less from the input impedance of the connection terminal.

5. (original) The gas concentration measurement apparatus according to claim 1, wherein said different potential pattern has a potential difference from the potential of the signal input pattern, said potential difference being 4 V or more.

6. (original) The gas concentration measurement apparatus according to claim 1, wherein said signal input pattern includes a plurality of signal input patterns, said different potential pattern includes a plurality of different potential patterns, and said measurement substrate comprises a surface conductive layer where the signal input patterns, the different potential patterns, and the guard pattern are formed; and an insulating layer on which the surface conductive layer is mounted, and

wherein said at least portion of the measurement substrate is located at a distance between at least one of the signal input patterns and at least one of the different potential patterns, said at least one of the signal input patterns and at least one of the different potential patterns being adjacent to each other.

7. (original) The gas concentration measurement apparatus according to claim 1, wherein said signal input pattern includes a plurality of signal input patterns, said different potential pattern includes a plurality of different potential patterns, said guard pattern includes a plurality of guard patterns, said measurement substrate comprises a plurality of conductive layers; and a plurality of insulating layers so that the conductive layers and the insulating layers are alternately laminated with each other, one of said conductive layers corresponding to a surface portion of the measurement substrate, another one of said conductive layers being adjacent to the one of the conductive layers through one of the insulating layers interposed therebetween, said signal input patterns are formed in the one of the conductive layers, said different potential patterns are formed in the one of the conductive layers, said guard patterns are formed in both of the one of the conductive layers and

another one thereof, respectively, said at least portion of the measurement substrate is located at a distance between at least one of the signal input patterns and at least one of the different potential patterns in the one of the conductive layers, said at least one of the signal input patterns and at least one of the different potential patterns is adjacent to each other therein, and

wherein at least one of said guard patterns formed in another one of said conductive layers is arranged in an area of another one of the conductive layers, said area being opposite to at least one of the signal input patterns formed in the one of the conductive layers.

8. – 9. (canceled)

10. (currently amended) The gas concentration measurement apparatus according to ~~claim~~ claim 1, wherein said signal processing circuit comprises an operational amplifier having non-reverse input terminal, a reverse input terminal and an output terminal, said reverse input terminal being electrically connected to the connection terminal, said operational amplifier being configured to control that the potential applied on the non-reverse input terminal substantially coincides with the potential of the connection terminal, said non-reverse input terminal of the operational amplifier being electrically connected to a portion of the signal measurement pattern, and said guard pattern is electrically connected to the portion of the signal measurement pattern.

11. (original) The gas concentration measurement apparatus according to claim 1, wherein said guard pattern is arranged to surround the signal input pattern.

12. (original) The gas concentration measurement apparatus according to claim 1, wherein said different potential pattern comprises an exposed portion around which no insulating coating is formed, and a coating portion around which an insulating coating is formed, and said guard pattern

comprises an exposed adjacent portion arranged adjacent to the exposed coating portion, and a coating adjacent portion arranged adjacent to the coating portion, said exposed adjacent portion being formed with no insulating film therearound, said coating adjacent portion being formed with an insulating film therearound.

13. (original) The gas concentration measurement apparatus according to claim 1, wherein said gas sensor comprises a pair of sensor cells each of which outputs the sensor current, said measurement substrate comprises a pair of the signal processing circuits, one of said signal processing circuit is electrically connected to one of said sensor cells, other of said signal processing circuits is electrically connected to other of said sensor cells, one of said signal processing circuits is configured to correct the sensor current outputted from one of said sensor cells according to the sensor current measured and outputted from the other of the signal processing circuit.

14. (original) The gas concentration measurement apparatus according to claim 1, wherein said specified gas component is one of NO_x, CO and HC.

15. (currently amended) A gas concentration measuring apparatus comprising:

a gas sensor configured to measure a concentration of a specified gas component contained in a gas and to output a sensor current corresponding to the measured concentration of the specified gas component; and

a measurement substrate where an electric circuit is formed, said electric circuit being electrically connected to the gas sensor and including a signal processing circuit configured to measure the sensor current outputted from the gas sensor,

wherein said electric circuit comprises:

a connection terminal electrically connected to the gas sensor and configured to ~~input~~receive

the sensor current from the gas sensor, said connection terminal having input impedance of 500 k Ω or over;

a conductive pattern portion having conductivity and formed in the measurement substrate;

and

an electric component mounted on the conductive pattern portion,

said conductive pattern portion including:

a signal input pattern ~~constituting the signal processing circuit and~~ electrically connected to the connection terminal, said signal input pattern having direct current impedance with respect to the connection terminal, said direct current impedance being 10 percent or less of the input impedance of the connection terminal;

a different potential pattern having a potential difference of 2 V or over from a potential of the signal input pattern; and

a guard pattern having a substantially constant potential within a range from 80 percent or more to 120 percent or less of the potential of the signal input pattern, said guard pattern being arranged on at least a portion of the measurement substrate, said at least portion of the measurement substrate being located between the signal input pattern and the different potential pattern,

wherein the guard pattern is arranged on at least a portion of the measurement substrate, the at least portion of the measurement substrate is located between the signal input pattern and the different potential pattern, the conductive pattern portion includes a signal measurement pattern constituting the signal processing circuit, a potential of the signal measurement pattern depends on that of the signal input pattern, the signal processing circuit comprises an operational amplifier, the signal input pattern is connected to a non-reverse input terminal of the operational amplifier so that the potential of the signal input pattern is input to the operational amplifier via the non-reverse input terminal thereof, an output terminal of the operational amplifier is connected to a reverse input terminal thereof so that the operational amplifier is configured to output, via the output terminal, a voltage that substantially

equals to the potential of the signal input pattern, and the guard pattern is electrically connected to the signal measurement pattern.

16. (original) The gas concentration measuring apparatus according to claim 15, wherein said guard pattern has a potential difference of less than 0.2 V from the potential of the signal input pattern.

17. (original) The gas concentration measuring apparatus according to claim 15, wherein said input impedance of the connection terminal has 1 M Ω or more.

18. (original) The gas concentration measurement apparatus according to claim 15, wherein said signal input pattern has direct current impedance of 2 k Ω or less from the input impedance of the connection terminal.

19. (original) The gas concentration measurement apparatus according to claim 15, wherein said different potential pattern has a potential difference from the potential of the signal input pattern, said potential difference being 4 V or more.

20. (original) The gas concentration measurement apparatus according to claim 15, wherein said signal input pattern includes a plurality of signal input patterns, said different potential pattern includes a plurality of different potential patterns, and said measurement substrate comprises a surface conductive layer where the signal input patterns, the different potential patterns, and the guard pattern are formed; and an insulating layer on which the surface conductive layer is mounted, and

wherein said at least portion of the measurement substrate is located at a distance between at least one of the signal input patterns and at least one of the different potential patterns, said at least one of the signal input patterns and at least one of the different potential patterns being adjacent to each

other.

21. (original) The gas concentration measurement apparatus according to claim 15, wherein said signal input pattern includes a plurality of signal input patterns, said different potential pattern includes a plurality of different potential patterns, said guard pattern includes a plurality of guard patterns, said measurement substrate comprises a plurality of conductive layers; and a plurality of insulating layers so that the conductive layers and the insulating layers are alternately laminated with each other, one of said conductive layers corresponding to a surface portion of the measurement substrate, another one of said conductive layers being adjacent to the one of the conductive layers through one of the insulating layers interposed therebetween, said signal input patterns are formed in the one of the conductive layers, said different potential patterns are formed in the one of the conductive layers, said guard patterns are formed in both of the one of the conductive layers and another one thereof, respectively, said at least portion of the measurement substrate is located at a distance between at least one of the signal input patterns and at least one of the different potential patterns in the one of the conductive layers, said at least one of the signal input patterns and at least one of the different potential patterns is adjacent to each other therein, and

wherein at least one of said guard patterns formed in another one of said conductive layers is arranged in an area of another one of the conductive layers, said area being opposite to at least one of the signal input patterns formed in the one of the conductive layers.

22. – 23. (canceled)

24. (currently amended) The gas concentration measurement apparatus according to ~~claim~~ claim 15, wherein said signal processing circuit comprises an operational amplifier having non-reverse input terminal, a reverse input terminal and an output terminal, said reverse input terminal

being electrically connected to the connection terminal, said operational amplifier being configured to control that the potential applied on the non-reverse input terminal substantially coincides with the potential of the connection terminal, said non-reverse input terminal of the operational amplifier being electrically connected to a portion of the signal measurement pattern, and said guard pattern is electrically connected to the portion of the signal measurement pattern.

25. (original) The gas concentration measurement apparatus according to claim 15, wherein said guard pattern is arranged to surround the signal input pattern.

26. (original) The gas concentration measurement apparatus according to claim 15, wherein said different potential pattern comprises an exposed portion around which no insulating coating is formed, and a coating portion around which an insulating coating is formed, and said guard pattern comprises an exposed adjacent portion arranged adjacent to the exposed coating portion, and a coating adjacent portion arranged adjacent to the coating portion, said exposed adjacent portion being formed with no insulating film therearound, said coating adjacent portion being formed with an insulating film therearound.

27. (original) The gas concentration measurement apparatus according to claim 15, wherein said gas sensor comprises a pair of sensor cells each of which outputs the sensor current, said measurement substrate comprises a pair of the signal processing circuits, one of said signal processing circuit is electrically connected to one of said sensor cells, other of said signal processing circuits is electrically connected to other of said sensor cells, one of said signal processing circuits is configured to correct the sensor current outputted from one of said sensor cells according to the sensor current measured and outputted from the other of the signal processing circuit.

28. (original) The gas concentration measurement apparatus according to claim 15, wherein said specified gas component is one of nitrogen oxides, carbon monoxide, and hydrocarbon.